Exploration of the Value of Safety and Construction Technology Management in On-site Construction of Building Engineering

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Abstract: In on-site construction of building engineering, safety management and construction technology management are core aspects that ensure project progress, with their collaborative effects being significant. This paper takes safety and construction technology management as the research object. By analyzing the problems faced by current on-site construction management in building engineering, it elaborates in detail on positive countermeasures to strengthen safety and construction technology management on construction sites. It aims to provide effective management references for the construction industry, thereby enhancing on-site safety and technical levels, and ensuring the smooth progress and high-quality completion of engineering projects.

1. Introduction

In the present construction site environment of building engineering, problems such as numerous high-altitude operations, widespread cross-construction between different types of work, and discrete use of heavy machinery are common. This means that on-site construction is always under the dual risks of safety accidents and quality hazards. At the same time, under the background of gradual transformation to high quality development in the construction industry, higher requirements for standardization and scientific project management keep emerging. Therefore, how to use a systematic and scientific way of management methods to make construction high efficiency on the basis of ensuring safety and engineering quality and provide an organic balance between these three has become a real problem that must be faced by construction industry in the process of development.

2. Problems Faced by Current On-site Construction Management in Building Engineering

2.1 Insufficient Synergy in the Management system and Disconnection between Responsibility and Execution

Furthermore, in the current act of on-site construction management for most building engineering projects, sub-parts like safety management, technology management and progress management mostly run alone without a unified collaborative mechanism at hand , which results in breaks to the management process. For a start, while the documentation surrounding each management module unambiguously delineates responsibilities and authority, "vaguely defined boundaries" tend to be prone to problems in their actual implementation. For instance, in safety management the results of investigations into safety hazards are not timely aggregated to the technology management interface which leads to incomplete coverage of safety risks when optimizing technical solutions. While special construction plans made by technology management may need to be changed during the course-progress management process due to weak connections, this results in repetition of processes. On the contrary, managerial system factual transmission by "top-down" is attenuated. The management standards the project headquarters has developed are poorly fitted to local on-site construction conditions. Grassroots managers often streamline management processes to advance progress, meaning institutional prescriptions are often hard to put into practice. In addition to increasing management costs, this phenomenon will also lead to the

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safety and quality hazards easily, so that there is a deviation between management objectives and field construction effect.

2.2 Uneven Comprehensive Literacy of Personnel and Lagging Management Concepts and Abilities

The on-site construction management personnel of building engineering has a relatively complex composition, including coordinating managers and technicians responsible for technology implementation, as well as front-line workers directly participating in operations. The literacy level of the personnel is different between positions, which brings many limitations to the development of on-site management work.

As for managers, some have been able to complete management duties through past experience in construction and do not deeply understand modern management theories, such as full-cycle collaborative management or risk pre-control. Due to limited time management and preparation, when encountering out-of-control events or high-complexity premise requirements on the project site, managers cannot quickly adjust their management strategies. Some technicians simply lack the mastery of new construction technologies and process standards in their field. The development of special technical plans or technical disclosures to front-line personnel does not fully consider the safety conditions on-site, and often conflict with safety management requirements when implementing construction plans, which can increase potential safety hazards.

2.3 Low Adaptability between Technology Application and Management Needs and Lagging Digital Transformation

And, in the wave of digitalization for construction industry development, many new technologies like BIM technology and intelligent monitoring equipment are gradually being applied to site construction management. But in the real application process, the "inconsistent functional and management requirements" problem is serious, which can not really give full play to the supporting role of technology management.

On the one hand, new technologies in some enterprises do have no systematic planning of combining project actual conditions to introduce, and may also be due to technology itself functions more attention rather than according to on-site management business needs for adaptive adjustment. As a concrete example, although BIM technology can realize the visual presentation of construction drawings and help technicians to sort out construction nodes more intuitively, there is no effective link mechanism with management links such as on-site safety hazard investigation and construction progress tracking, resulting in inability to transform technological advantages into real management effect and making new technologies merely "formal tools.". The "fragmented application" phenomenon of technology is also very obvious. Each module of on-site management uses independent data structure technological tools and lacks interconnection channels between such tools. The safety monitoring system collects risk data, and when a safety incident occurs, this information cannot be transmitted to the progress management system in real time, making it difficult for managers to understand overall project status at a glance due to insufficient data integration and failure to identify the associated problem between safety risks and delays in some construction activities.

3. The Value of Safety and Construction Technology Management in On-site Construction of Building Engineering

3.1 Building a Solid Safety Line for On-site Construction and Avoiding Risks to Ensure Project Stability

For building engineering on-site construction, safety management is responsible for establishing a full-process risk prevention and control system to prevent all kinds of safety accidents from the source and laying a good foundation for the smooth construction of the project. In particular, the safety management will establish a responsibility transfer mechanism in that first orderly from

project general manager to each front-line operator and then relevant requirements can be carried out at each construction link as material entry, equipment operation and process connection so there is no "invisible" responsibility in all links.

Simultaneously, safety management will also be beneficial to the field personnel regarding aware of eliminating hidden dangers and standardizing operational habits through frequent safety training opportunities as well as providing accurate technical information. Such as the clarifying requirements of wearing protective articles during high-altitude operations and inspection procedures before mechanical startup will fundamentally mitigate hidden dangers resulting from non-standard behaviors or inadequate awareness of safety. Also, due to the fact that the construction conditions on site are changing all the time, in terms of safety management you will do real-time hazard investigation and have a closed-loop management mode for "hazard discovery rectification implementation re-inspection confirmation" process. It realizes the timely discovery of potential problems in high-risk links such as high-altitude operations, mechanical use and temporary electricity use relates to the safe production process, adjustable prevention and control measures according to the construction progress with a view to preventing risks from accumulating and leading to accidents [1].

3.2 Improving Engineering Quality and Construction Efficiency and Optimizing Project Resource Allocation

Construction technology management in on-site construction, the core role is mainly reflected in accurately controlling engineering quality, scientifically improving construction efficiency, and then helping the project optimize resource allocation. For quality control, construction technology management will first conduct profound drawing review and optimize construction plan to remedy mismatch between design drawings and site conditions in advance. Such as to adjust the construction method of complex structural nodes, clear technical standards and quality bottom line for each procedure to avoid later design and actual disconnection rework.

Meanwhile, for major processes including binding of steel bars, pouring of concrete and welding of steel structures, construction technology management will allocate technical personnel to guide the operation on location and inspect randomly during construction so that each operation conforms with norms and avoids quality problems arising from poor technology while ensuring that the final qualified engineering quality meets standards. In addition to promoting the application of technological innovation, construction technology management also promotes it more. It promotes the utilization of new technologies, materials, and processes to enhance the quality of engineering and construction efficiency; conducts regular technical exchanges and training to help the team mastering the latest technological methods; establishes archives and databases for technical issues, recording any technical difficulties encountered during project construction as well as solutions to solve those issues in order to facilitate future projects. Not only can these practices help mitigate the extra costs involved in rework further down, but it could also reduce the time a project takes allowing a project to simultaneously hit KPIs for quality and progress while staying within a manageable range of cost.

3.3 Strengthening Enterprise Core Competitiveness and Assisting in High-quality Development of the Industry

To sum up, the promotion of safety and construction technology management not only has direct value to individual projects but also helps enhance the core competitiveness of construction enterprises in the long run. At the enterprise level, good safety management and effective technology management can make the enterprise have high-quality engineering cases as well as a good ability to bid and competitiveness in the market. In addition, the internal management standard system can be established within the enterprise through accumulation of management practices and methods, which will reduce the management costs of subsequent projects and improve operational efficiency. At the industry level, promoting safety and construction technology management popularization and optimization can also drive the industry to break free from the traditional extensive management model of "emphasizing progress over safety" and "emphasizing experience

over technology", guiding enterprises to achieve standardized, refined, digital transformation.

4. Positive Countermeasures to Strengthen Safety and Construction Technology Management on Construction Sites

4.1 Building a Collaborative Management System and Strengthening Responsibility Closure and Process Connection

The first step in strengthening the management of safety and construction technology on construction sites is to dismantle the barriers between management modules and build a collaborative management system of "safety - technology - progress - cost". This requires on the one hand clarification of the core responsibilities and connection nodes of each management module, and establishing a cross-department communication mechanism. For instance, in the construction plan formulation link, it is necessary to put forward opinions from both safety management department and the technology type for review at the same time according to the angles of safety risk prevention and technical feasibility so that an engineering plan can not only meet technical conditions but also avoid safety hazards. The closed-loop process of "investigation - feedback - optimization - verification" stipulates that in the hazard investigation work, the safety management department must synchronize the investigation results to the technology department, and then provide correction measures for construction processes or protective equipment repairs. The responsibilities of the assignment must be consolidated, and it is necessary to refine the management responsibilities from "spaces" to positions and people. At present, it is essential that management responsibilities can be transferred from project leaders to front-line team leaders, implement signing responsibility letters layer by layer, and keep assessment regularly made. And at the same time, it is necessary to optimize the management process according to the actual situation of the project, and simplify unnecessary approval links to improve management efficiency. A graded approval system for minor technical adjustments can be developed to avoid long procedures hindering construction progress and ensure a standardized versionised yet adaptive collaborative management system capable of dynamic on-site requirements [2].

4.2 Improving the Full-cycle Personnel Training System and Enhancing Comprehensive Literacy and Management Abilities

Personnel Personnel are the basic embodiment of on-site management. Personnel Training and Establishing a Full-cycle Management System in Technology The first step to strengthening safety management for construction technology is personnel training. During selection process it is required to specify talent level requirements for respective hiring positions. In the technical management level, in addition to professional technical qualifications, it is important to evaluate whether the person engaged can find safety hazards. Front-line operators should be prioritized for selection from personnel with safety Operation experience and norm awareness, to enhance the quality of the base team from the source. The training is some data that must be carefully designed according to the different positions. For managers, enhance training on modern management concepts and collaborative management technology, more common new technological applications theory to let them shake off the dependency of traditional experience management and master scientific management tools. For technicians, reinforce training on new technologies, new processes and new norms (especially content related to safety management connections such as safety technical disclosures and risk prediction) to enhance their ability to adapt technical solutions into functionality that meets safety requirements. For operation management personnel for front-line operators, carry out focused training of safety operation norms and method of identifying the hazard, strengthen safety awareness by case explanation and practical practice to implement "passive obedience" changing into "active prevention and control". Moreover, it must establish a dynamic evaluation mechanism, connect training effects with promotion as well as salary; adjust the roles of staff who do not pass an evaluation or re-train them and offer advanced learning opportunities to top performers such as participating in industry technical exchanges and special project research so that

personnel shift techniques can be done constantly,stronger, and fresher areas, providing talent support for on-site management.

4.3 Promoting the Deep Integration of Technology and Management and Accelerating Digital Transformation and Application Landing

In terms of digital development, strengthening on-site management by promoting the deep integration of technological tools and management needs, using digital means to achieve accurate and efficient safety technology and construction technology management. First, it is necessary to formulate a technology application plan that is closely integrated with the actual needs of on-site management pain points, and clarify the application scenarios and objectives of various technological tools. So for combining monitoring and forecasting data natural language processing, machine learning and even deep learning can be used to complement static risk management in a continuous manner. For case reviews and plan optimization of technology management, we can vigorously promote the full-process application of BIM technology to realize functions such as drawing visualization, process simulation and collision detection, and find out design and construction conflicts in advance so as to save a lot of rework subsequently. The second is to break data barriers of technology tools, promote mutual interconnection and interoperability between different systems. Example: Integration of safety monitoring system and technology management system and progress management system data into a unified platform to realize real-time data sharing linkage analysis, managers can intuitively grasp the project safety status/technical progress quality situation through the platform, comprehensive control capability improvement. Exactly at the same time, it is also necessary to increase the quality of technology application training for grassroots managers; organizing practical training on new digital tools that should be implemented; simplifying operation processes to accompany simple and easy-to-understand operation manuals so that managers are skilled in work using technological tools. Meanwhile, it is also feasible to set up a technology application evaluation mechanism to timely evaluate the effects of technical tools on site application and follow the needs of the construction management staff adjusting and optimizing them when necessary, making sure that technology application will not be just formalism, but effectively working in improvement of digital technology into an important support force improving our safety and construction technology management effectiveness both needed on-site [3].

5. Conclusion

To sum up, safety and construction technology management in on-site construction of building engineering are key supports for project success core levers to promote the transformation from the "extensive" type of construction industry to the "refined level". In the real-life engineering practice, construction enterprises need to abandon this wrong idea of "emphasizing form over reality", and organically combine these countermeasures with full-cycle project management. This will continuously avoid on-site construction risks, ensure engineering quality and personnel safety, reduce management costs, improve project benefits, and win market competitiveness for enterprises so that the high-quality development of the construction industry can be firmly guaranteed.

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